CLAIMS

1. A perpendicular magnetic recording medium comprising:

a substrate;

at least one underlayer formed above the substrate; and

a perpendicular magnetic recording layer formed above the at least one underlayer, an easy magnetization axis of the perpendicular magnetic recording layer being oriented perpendicular to the substrate, the perpendicular magnetic recording layer including magnetic crystal particles and grain boundaries surrounding the magnetic crystal particles,

wherein the grain boundaries contain an oxide of silicon and at least one element selected from the group consisting of Li, Na, K, Rb, Cs, Ca, Sr, and Ba, and

the ratio of a total amount of substance of Si, Li, Na, K, Rb, Cs, Ca, Sr, and Ba in the perpendicular magnetic recording layer is no less than 1 mol% and no more than 20 mol%.

2. The perpendicular magnetic recording medium according to claim 1, wherein a ratio of total amount of substance of Li, Na, K, Rb, Cs, Ca, Sr, and Ba contained at the grain boundaries in the perpendicular magnetic recording layer is no less than 1 mol% and no more than 30 mol%.

3. The perpendicular magnetic recording medium according to claim 1, wherein the magnetic crystal particles contain Co as the main component and further contains Pt and Cr.

4. The perpendicular magnetic recording medium according to claim 1, wherein at least one of the at least one underlayer contains at least one element selected from the group consisting of Ru, Ti, Rh, Pt, Pd, and Ir as a main component.

5. The perpendicular magnetic recording medium according to claim 1 wherein, at least one of the at least one underlayer is made of non-magnetic crystal particles containing at least one element selected from the group consisting of Ru, Ti, Rh, Pt, Pd, and Ir as a main component, and grain boundaries surrounding the non-magnetic crystal particles, and

the grain boundaries contain an oxide of at least one element selected from the group consisting of Si, Cr, and Ti.

6. The perpendicular magnetic recording medium according to claim 5, wherein the grain boundaries in at least one of the at least one underlayer contain an oxide of silicon and at least one element selected from the group consisting of Li, Na, K, Rb, Cs, Ca, Sr, and Ba.

7. The perpendicular magnetic recording medium according to claim 6, wherein a ratio of total amount of substance of Si, Li, Na, K, Rb, Cs, Ca, Sr, and Ba in the at least one underlayer is no less than 1 mol% and no more than 20 mol%.

8. The perpendicular magnetic recording medium according to claim 6, wherein a ratio of total amount of substance of Li, Na, K, Rb, Cs, Ca, Sr, and Ba contained at the grain boundaries in the at least one underlayer is no less than 1 mol% and no more than 30 mol%.

9. A method for producing a perpendicular magnetic recording medium comprising the steps of:

forming at least one underlayer over a substrate, and

forming a perpendicular magnetic recording layer formed above the at least one underlayer by evaporating a material which contains an oxide of silicon and at least one element selected from the group consisting of Li, Na, K, Rb, Cs, Ca, Sr, and Ba, the perpendicular magnetic recording layer including magnetic crystal particles and grain

boundaries surrounding the magnetic crystal particles.

10. The method for producing a perpendicular magnetic recording medium according to claim 9, wherein the grain boundaries in the perpendicular magnetic recording layer contain an oxide of silicon and at least one element selected from the group consisting of Li, Na, K, Rb, Cs, Ca, Sr, and Ba.

11. The method for producing a perpendicular magnetic recording medium according to claim 9, wherein the ratio of a total amount of substance of Si, Li, Na, K, Rb, Cs, Ca, Sr, and Ba in the perpendicular magnetic recording layer is no less than 1 mol% and no more than 20 mol%.

12. The method for producing a perpendicular magnetic recording medium according to claim 9, wherein a ratio of total amount of substance of Li, Na, K, Rb, Cs, Ca, Sr, and Ba contained at the grain boundaries in the perpendicular magnetic recording layer is no less than 1 mol% and no more than 30 mol%.

13. The method for producing a perpendicular magnetic recording medium according to claim 9, wherein the magnetic crystal particles contain Co as the main component and further contains Pt and Cr.

14. The method for producing a perpendicular magnetic recording medium according to claim 9, wherein at least one of the at least one underlayer contains at least one element selected from the group consisting of Ru, Ti, Rh, Pt, Pd, and Ir as a main component.

15. The method for producing a perpendicular magnetic recording medium according to claim 9, wherein

at least one of the at least one underlayer is made of non-magnetic crystal

particles containing at least one element selected from the group consisting of Ru, Ti, Rh, Pt, Pd, and Ir as a main component, and grain boundaries surrounding the non-magnetic crystal particles, and

the grain boundaries contain an oxide of at least one element selected from the group consisting of Si, Cr, and Ti.

16. The method for producing a perpendicular magnetic recording medium according to claim 15, wherein a ratio of the oxide of at least one element selected from the group consisting of Si, Cr, and Ti at the grain boundaries in the at least one underlayer is no less than 1 mol% and no more than 20 mol%.

17. The method for producing a perpendicular magnetic recording medium according to claim 15, wherein the grain boundaries in at least one of the at least one underlayer contain an oxide of silicon and at least one element selected from the group consisting of Li, Na, K, Rb, Cs, Ca, Sr, and Ba.

18. The method for producing a perpendicular magnetic recording medium according to claim 17, wherein a ratio of total amount of substance of Li, Na, K, Rb, Cs, Ca, Sr, and Ba contained at the grain boundaries in the at least one underlayer is no less than 1 mol% and no more than 30 mol%.

19. A magnetic read/write apparatus comprising the perpendicular magnetic recording medium according to claim 1 and a read/write head.

20. The magnetic read/write apparatus according to claim 19, wherein the read/write head is a single magnetic pole recording head.